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The Role of Demand Forecasting Analysis (Case Study: Bio Farma for Papua Area)

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ABSTRACT: Bio Farma as the only vaccine manufacturer in Indonesia, divides its marketing area for vaccine distribution throughout Indonesia, represented by marketing representatives in 34 provinces in Indonesia. Segmentation based on geography for vaccine products is divided into five regions, one of the region is Papua. The forecast method used in Bio Farma for Papua Area is still manual. Marketers order vaccines from central Bio Farma and make forecasts if product stock is empty. If the product is empty, a buffer stock will be created. With the buffer stock system that has been implemented so far, there are often problems with excess product which causes the product to expire. From the data, the total loss due to overstock is Rp. 14,161,693 in 2022. If consumer demand falls short of expectations, it will definitely have an impact on the manufacturing of high inventory value, even leading to lost opportunities for sales. That is the fundamental issue with this research. The goal of this research is to identify the possible causes for the overstock and to identify a suitable solution for those issues.
There are five things consist of root causes the problem; (1) fully manual forecasting, (2) low sales forecast accuracy, (3) sales forecasting based on sales of the last one or two months, (4) lack of employee knowledge about sales forecasting, (5) significant gap between target and actual sales. The alternate strategy recommended is to provide a forecasting technique that is suitable for the company. Different forecasting techniques were selected to be compared in order to determine which may be used to improve forecasting accuracy. The forecasting techniques that are employed are the 3-month simple moving average, the 5-month simple moving average, the 3-month weighted moving average, the 5-month weighted moving average, and exponential smoothing. By using the MAD and MAPE measurement tools, exponential smoothing showed the most acceptable accuracy result.

KEYWORDS: Accuracy measurement, Demand forecast, Forecast accuracy, Sales forecasting, Time series.

INTRODUCTION

Bio Farma as the only vaccine producer has marketing representatives in 34 provinces in Indonesia. The marketing representative works closely with Kimia Farma distributors as distributors who distribute Bio Farma products to consumers in those areas. Every marketing representative of Bio Farma is required to carry out product forecasting to the central Bio Farma as a buffer stock for these areas in 34 provinces in Indonesia. Currently, the Papua marketing area at Bio Farma does not use a system for product forecasting. To place an order for products to the central Bio Farma as a buffer stock in the Papua area, the marketer as the party responsible for controlling stock and ordering stock in the Papua area. Usually, Marketers will do forecasting once a month for buffer stock, but if the stock is empty before the forecasting schedule, it is possible to do forecasting. In forecasting, marketers only order products with estimates based on sales for the last 1 or 3 months in the Papua area. With the forecasting system used today, there are often problems such as overstock, expired products and product shortages.
The vaccine is being sold through representatives in each region of Indonesia by PT Bio Farma. Bio Farma marketers will get sales targets from the central Bio Farma for each vaccine product. One of the ways that Bio Farma for the Papua Area fulfills customer orders is by utilizing buffer stock. There is a minimum order for vaccine products for each region in Indonesia and for the Papua area the minimum order for vaccines to the central Bio Farma is 25 million rupiah. For 2022 from January to June the target and actual sales for each vaccine product are explained as shown in figure 1.

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Figure 1. Sales Target vs Actual Sales

Based on figure 1, there is a significant gap in what has been targeted with actual sales for flubio, HBV and premium vaccine products. For Flubio products, the target from the center of Bio Farma for January-June was to sell 2840 products, but only 454 products were sold. For HBV products, the target is to sell 5561 products, but only 470 products are sold.

Based on data collection, the forecast method used in Bio Farma for Papua Area is still manual. Marketers order vaccines from central Bio Farma and make forecasts if product stock is empty. If the product is empty, a buffer stock will be created. With the buffer stock system that has been implemented so far, there are often problems with excess product which causes the product to expire. Below is data on vaccine products that are overstocked in 2022. From the table below, it can be seen that the total loss due to overstock is Rp. 14,161,693. This is caused by the inaccurate forecast made by the Marketer.

Table 1. Overstock at Bio Farma for Papua Area

Material Number	Material Description	SLED/BDD	Stock	UoM	Total Value	Principle
12007741	MEASLES AND RUBELLA VACCINE 5 ML	30/08/22	15	Vial	5.610.000	BIOFARMA
12007662	FLUBIO	28/02/22	94	Vial	8.443.080	BIOFARMA
12007659	VAKSIN CAMPAK KERING	31/10/22	1	Vial	108.613	BIOFARMA

The focus of this research is to identify the underlying factors that led to the overstock at Bio Farma Papua Area. Both quantitative data and an interview with a Bio Farma Papua Area employee will be used in this study.

LITERATURE REVIEW

A. Forecasting

The term "forecasting" is commonly used in the business world. Managers usually make crucial business decisions without having a clear understanding of what tomorrow's future will look like. Managers should make every effort to reduce uncertainty as much as they can because it is one of the biggest enemies of company. As a result, accurate forecasting is one of the most important "treatments" that could reduce the effects of uncertainty for business processes (Render et al., 2012). According to Dayanada, all sectors of business require forecasting. The demand for different sorts of supermarket products must be estimated. The demand for the various types of cars that a company makes must be predicted. When choosing which crops to grow in the spring, a farmer must predict the demand for a variety of crops. A company's business processes require it to make predictions about the sorts of labor inputs, raw materials, equipment, and structures that will be needed in the future. So, every company organization must make future plans. The ability of management to predict the future and devise effective plans has a direct impact on the performance of a business organization. Without forecasts for the products and services it offers and the inputs it buys, no corporate organization can operate efficiently (Dayanada, 2002).

Forecasting is the process of attempting to predict future conditions based on the analysis of the past. The goal of forecasting is to make predictions about future events and to use past trends to inform current decisions. Forecasts are used by production and

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operations staff to make ongoing decisions regarding purchasing, production planning, scheduling, and inventory as well as for periodic decisions affecting supplier selection, process selection, capacity planning, and facility layout.

B. Types of Forecasting Models

Figure 2 shows various forecasting models that are commonly applied and categorized by model type. The first category uses qualitative models, whereas the others are quantitative and rely on mathematical calculations to produce more accurate forecasts.

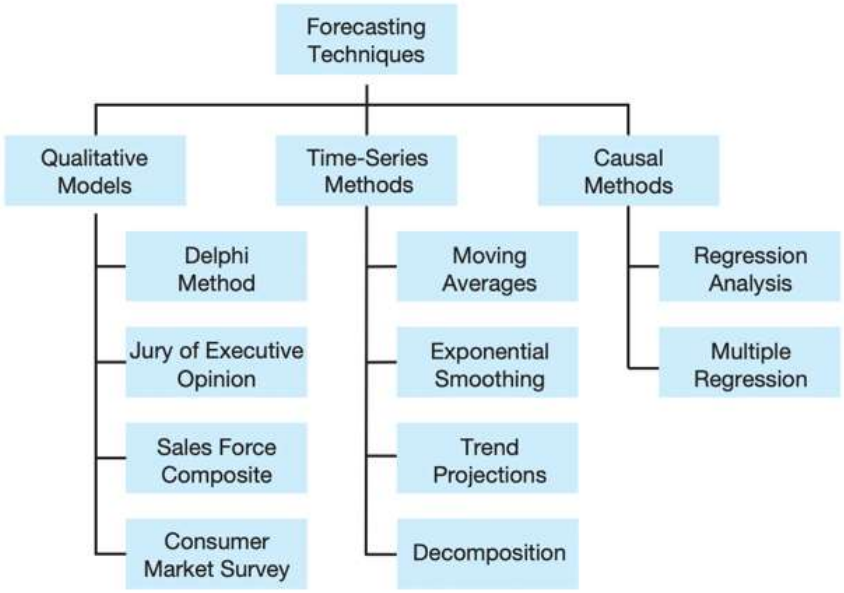

Figure 2. Forecasting Models

1. Casual Method

When historical numerical data is available, a range of quantitative forecasting models are accessible. If the forecasting variable is influenced by or linked with other variables in the model, forecasting models are referred to as casual models (Render et al., 2012).

2. Qualitative Models

Qualitative forecasting methods don't require as much data. The input requirements vary depending on the method and are mostly the result of experience and collected knowledge. The qualitative method makes use of professional judgments, personal experiences, and other subjective aspects that are taken into account in decision-making as a result of the forecasting that has been done (Narkevičius & Šeškauskis, 2016).

Here is a quick summary of four distinct qualitative forecasting methods:

- Delphi Method

Forecasts can be made by experts from several locations using this iterative group procedure. Decision-makers, staff members, and respondents are the three different sorts of participants in the Delphi process. The actual forecast will be made by the decision-making group, which typically includes of 5 to 10 specialists. A number of questionnaires and survey findings are prepared, distributed, gathered, and summarized by the staff members in order to aid the decision-makers. The respondents are a group whose opinions are respected and sought after. Before making a forecast, this group gives the decision-makers input (Render et al., 2012).

- Jury of Executive Opinion

Two of the more common judging forecasting methods are Jury of Executive Opinion and Sales Force Composite. A top-down forecasting method known as "jury of executive opinion" involves the ad hoc synthesis of predictions and opinions given by knowledgeable executives and specialists (Kahn, 2014).

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- Sales Force Composite

This method involves each salesperson forecasting the amount of sales that will occur in their specific location. These forecasts are then examined to make sure they are reasonable and pooled at the district and national levels to get an overall forecast. A sales force using a bottom-up forecasting method called composite, individual projections, usually from salespeople, are combined to produce a composite forecast at a higher level (Martinovic & Damnjanovic, 2006).

- Consumer Market Survey

With this approach, new or current customers are asked for their thoughts on the future, making plans to buy. It can assist with forecasting as well as product design and the planning of new products. To be effective, this strategy must guarantee that customers plan their purchases in advance and that they can afford to do so (Mentzer & Moon, 2005).

3. Time-Series Methods / Quantitative Models

Time series forecasting models use historical data to make predictions about the future. For instance, it is possible to predict sales for the seventh week using sales data gathered during the previous six weeks. Future quarters can be predicted using quarterly sales data gathered over the preceding few years. Despite the fact that both examples involve sales, several forecasting time series models would probably be employed (Jacobs & Chase, 2018).

There are other factors to consider when choosing a forecasting model, like the firm's level of flexibility. (The requirement for an accurate forecast decrease as one's capacity to respond swiftly to changes increases.) Another point is the result of a poor forecast. If a projection is going to be used as the basis for a significant capital investment decision, it needs to be accurate.

a. Simple Moving Average: When demand for a product is neither growing nor declining rapidly, and if it does not have seasonal characteristics, a moving average can be useful in removing the random fluctuations for forecasting. The idea here is to simply calculate the average demand over the most recent periods. Each time a new forecast is made, the oldest period is discarded in the average and the newest period included. The formula for a simple moving average is:

$$F_t = \frac{A_{t-1} + A_{t-2} + A_{t-3} + \ldots + A_{t-n}}{n}$$

Ft = Forecast for the coming period
n = Number of periods to be averaged
At-1 = Actual occurrence in the pas period
At-2, At-3, and At-n= Actual occurrences two periods ago, three periods ago and so on, up to n periods go

b. Weighted Moving Average: Whereas the simple moving average assigns equal importance to each component of the moving average database, a weighted moving average allows any weights to be placed on each element, provided, of course, that the sum of all weights equals. The formula for a weighted moving average is:

$$F_t = w_1 A_{t-1} + w_2 A_{t-2} + \ldots + w_n A_{t-n}$$

w1 = Wight to be given to the actual occurrence for the period t¬¬–-1
w2 = Wight to be given to the actual occurrence for the period t¬¬–-2
w3 = Wight to be given to the actual occurrence for the period t¬¬–-3
n = Total number of prior periods in the forecast

c. Exponential Smoothing: A time series forecasting technique using weight that decrease exponentially (1–□) for each past period. Exponential smoothing is the most used of all forecasting techniques. It is an integral part of virtually all computerized forecasting programs, and it is widely used in ordering inventory in retail firms, wholesale companies, and service agencies. Exponential smoothing techniques have become well accepted for six major reasons:
   - Exponential models are surprisingly accurate.
   - Formulating an exponential model is relatively easy.
   - The user can understand how the model works.
   - Little computation is required to use the model.

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- Computer storage requirements are small because of the limited use of historical data.
- Tests for accuracy as to how well the model is performing are easy to compute.

In the exponential smoothing method, only three pieces of data are needed to forecast the future: the most recent forecast, the actual demand that occurred for that forecast period, and a smoothing constant alpha (α); The parameter in the exponential smoothing equation that controls the speed of reaction to differences between forecast and actual demand. The equation for a single exponential smoothing forecast is simply:

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$$

Ft = The exponentially smoothed forecast for period t
Ft−1 = The exponentially smoothed forecast made for the prior period
At−1 = The actual demand in the prior period
α = The desired response rate, or smoothing constant

Exponential Smoothing with Trend: Exponentially smoothed forecasts can be corrected somewhat by adding in a trend adjustment. To correct the trend, we need two smoothing constants. Besides the smoothing constant α, the trend equation also uses a smoothing constant delta (δ). Both alpha and delta reduce the impact of the error that occurs between the actual and the forecast. If both alpha and delta are not included, the trend overreacts to errors.
The equations to compute the forecast including trend (FIT) are:

$$F_t = \mathrm{FIT}_{t-1} + \alpha(A_{t-1} - \mathrm{FIT}_{t-1})$$
$$T_t = T_{t-1} + \delta(F_t - \mathrm{FIT}_{t-1})$$
$$\mathrm{FIT}_t = F_t + T_t$$

Ft = The exponentially smoothed forecast that does not include trend for period t
Tt = The exponentially smoothed trend for period t
FITt = The forecast including trend for period t
FITt−1 = The forecast including trend made for the prior period
At−1 = The actual demand for the prior period α = Smoothing constant (alpha)
δ = Smoothing constant (delta)

C. Measurement of Error

Several common terms used to describe the degree of error are standard error, mean squared error (or variance), and mean absolute deviation (MAD). In addition, tracking signals may be used to indicate any positive or negative bias in the forecast. An additional measure of error that is often useful is the mean absolute percent error (MAPE).

a. Mean Absolute Deviation (MAD) is the average of the absolute value of the actual forecast error.

$$\mathrm{MAD} = \frac{\sum_{t=1}^{n} |A_t - F_t|}{n}$$

t =Period number
At = Actual demand for the period t
Ft = Forecast demand for the period
n = Total number of periods
‖ = A symbol used to indicate the absolute value disregarding positive and negative sign

When the errors that occur in the forecast are normally distributed (the usual case), the mean absolute deviation relates to the standard deviation of the error terms as:

$$1 \text{ standard deviation} \approx \sqrt{\frac{\pi}{2}} \times \mathrm{MAD}, \text{ or approximately } 1.25 \text{ MAD}$$

1 MAD is approximately 0.8 standard deviation

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b. Mean Absolut Percent Error (MAPE) is the average error measured as a percentage of average demand.

$$MAPE = \frac{100}{n}\sum_{t=1}^{n}\left[\frac{|A_t - F_t|}{A_t}\right]$$

This is a useful measure because it is an estimate of how much error to expect with a forecast. The real value of the MAPE is that it allows to compare forecasts between products that have very different average demand.

c. Tracking Signal (TS) is a measurement that indicates whether the forecast average is keeping pace with any genuine upward or downward changes in demand. When a forecast is consistently low or high, it is referred to as a biased forecast.

$$TS = \frac{RSFE}{MAD}$$

RSFE = The running sum of forecast errors, considering the nature of the error. (For example, negative errors cancel positive errors and vice versa.)
MAD = The average of all the forecast errors (disregarding whether the deviations are positive or negative). It is the average of the absolute deviations.

D. Conceptual Framework

A conceptual framework is a key component of research that determines the standard and depth of studies. A conceptual framework is a set of ideas, presumptions, expectations, convictions, and hypotheses that serves as a foundation for and guide for study (Miles & Huberman, 1994). The goal of this study is to improve demand forecasting so that it may be used in the business to better manage inventories. The proposed improvement plan will employ quantitative historical data as the major source of information to calculate the demand prediction number.

As described in chapter one, the business issues in Bio Farma for Papua Area are still having issues managing the target and actual sales. This happened because the forecast method used in Bio Farma for Papua Area is still manual. If the product in Papua Area is empty, a buffer stock will be created. By using a buffer stock system, there are often problems with high inventory value which causes the product to expire. And the inaccurate forecast causes overstock.

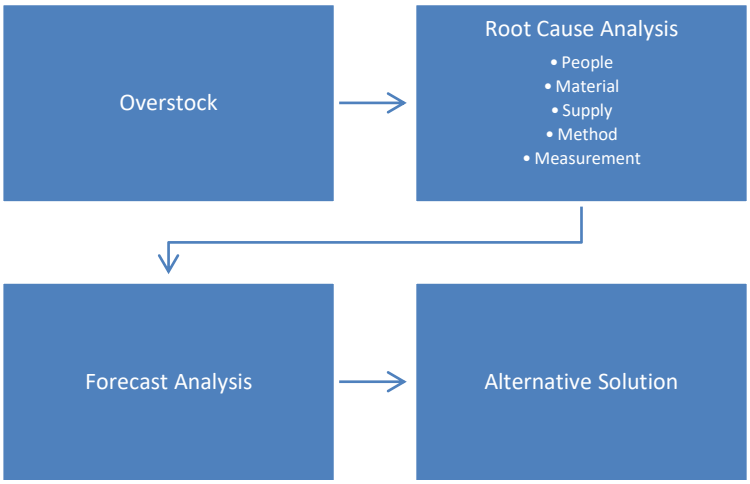

Figure 3. Conceptual Framework

To find the causes that lead to stock issues at Bio Farma for Papua Area. analysis will be done using root cause analysis with Ishikawa Diagram that using five factors (People, Material, Supply, Method, and Measurement). Once the problem that arises from the aforementioned factors is identified and justified, alternative solutions will be formulated. The factors are based on the variables mentioned in the company discussion. Keeping enough inventory on hand can have certain advantages for the business, such as better protection against order delays and increased customer satisfaction via meeting order needs. But having excessive inventories can harm the business in many ways since it interferes with its ability to make a profit. The solution formulated will be based on

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the forecasting solution. The forecasting analysis will give the company insight into alternative forecasting methods other that the one the company already used.

RESEARCH METHODOLOGY

A. Data Collection

To be able to collect the right data the author has reviewed a lot of journals, previous research about historical forecasting practices and books. By doing this, the author has learned a lot about different methods and their application. To assess the problems that have occurred in the company, this study will mostly use qualitative data. Quantitative data will also be used to improve the forecasting system. A mix of qualitative and quantitative research approaches was utilized because the research's objective could only be reached by looking at quantitative data and researching the current forecasting system.

The data collection will be taken into consideration when deciding which options are best to deal with the issue the company is facing and to determine the underlying causes of the overstock at Bio Farma Papua Area.

B. Secondary Data

There were no significant challenges in obtaining the information required for this research because forecasting is a common issue in the corporate industry. Only reliable and valid sources of information were used in order to obtain the finest solutions. Scientific publications and books were the two main sources of information. When it comes to the books, the majority of the theoretical background were obtained from famous forecasting researchers F. Robert Jacobs & Richaed B. Chase. However, the information found in books mainly provided a general theoretical framework of forecasting concepts which was not enough for desired study outcome.

C. Semi Structured Interview

A semi-structured interview is a technique for gathering data that depends on formulating questions within a pre-established theme framework. But neither the questions' arrangement nor their wording is predetermined. Semi-structured interviews are frequently of the qualitative variety in research. Semi-structured interviews are a popular way to gather data for qualitative studies, and the effectiveness of the interview guide has a significant impact on the study's findings. The goal of this research was to create a strict instrument for this purpose since, despite the popularity of this data collection technique, there is a lack of consistent, global guidance on how to design a semi-structured interview guide in the literature (Kallio et al., 2016).

D. Documentation

Because this study was specifically focused on the topic of forecasting research, historical sales data was an essential component for reaching the desired outcomes. The majority of the techniques have as their main input necessary data. It was simple to enter all the data because we received the collected materials as an Excel file.

E. Research Methodology

The research method is a scientific method used to produce data to achieve certain goals. In this research, the type of research used is descriptive research using quantitative research method. Research methodology is science of studying how research is done scientifically. Methodology helps to understand not only the products of scientific inquiry but the process itself (Patel & Patel, 2019).

This research tries to offer alternative solutions to problems at Bio Farma for Papua Areas that may have led to a large discrepancy between expected and actual sales, which resulted in an overstock of a product. Both qualitative and quantitative data must be obtained and interpreted in order to achieve the thesis's objectives. Secondary data, semi-structured interviews, and data documentation were used in data gathering methods to identify the issues.

After all the factors were collected and justified, the root cause of the issue is going to be identified using Ishikawa diagram or fishbone diagram. Fishbone diagram is a graphical method of illuminating the various root causes of a given event or occurrence. Fishbone diagram is a frequently used technique for cause-and-effect analysis to find a complex interplay of reasons for a given issue or incident. In the management research field, Ishikawa (1990) produced this causal diagram (Coccia, 2018). The selected factors as possible root causes will be discussed further to formulate the alternative business solutions for Bio Farma Papua Area's inventory management.

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F. Research Design

The research design is the framework of research approaches and techniques used by a researcher to conduct research. The figure below shows the research design flowchart.

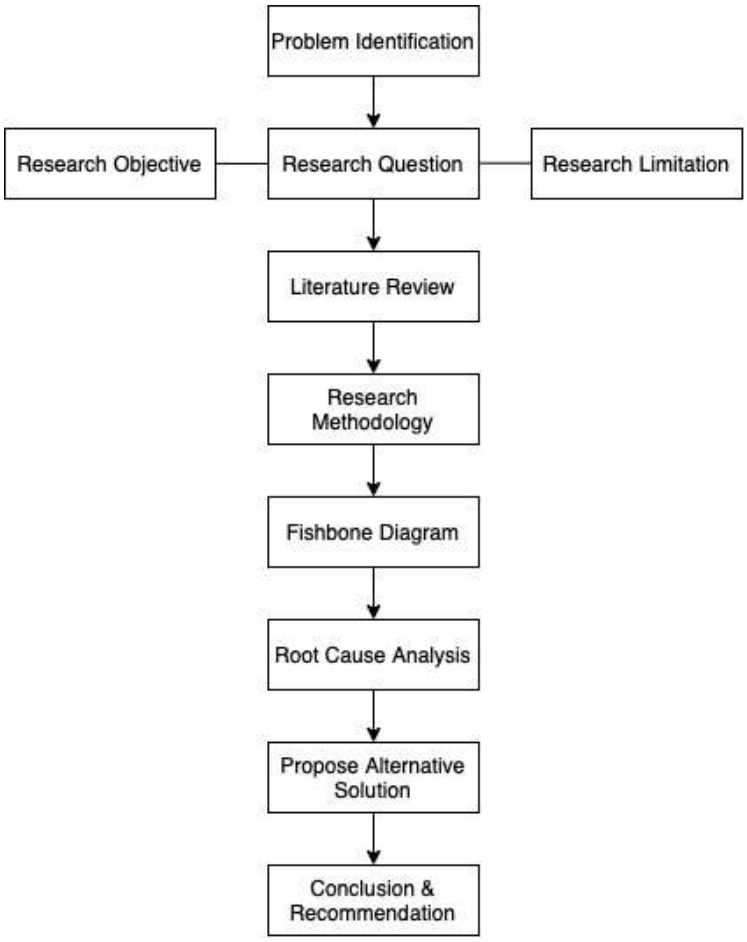

Figure 4. Research Design

There are various activities carried out at this stage. The first stage is problem identification to identify possible business problems contained in business processes to be discussed as material for business research. After identifying the problems, the next activity is to determine the objectivities of the business research to be carried out by considering the scope and limitations of the business research, as well as preparing questions related to the problems that arise in the business process. The next activity is to prepare all the literature reviews to get information to this research, in order to get the best possible solutions only reliable and justified information sources were used. The next stage is to collect all the data that relevant to the business research. Fishbone diagram is used to analyze the possible root causes of the business problems. After all the possible root causes were identified, the next stage is analyzing each possible root causes to be selected problems. The next stage is proposed alternative business solution and the last stage is create conclusion and recommendation for the next research.

DATA SOLUTION

A. Analysis

To identify the internal causal factors from the previous chapter, root cause analysis was done. There are several solutions to the issues related to the overstock at Bio Farma Papua Area based on root cause analysis.

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Table 2. Alternative Solutions

Root Causes	Alternative Solutions
Lack of employee knowledge about sales forecasting	Training the employees about forecasting system
Sales forecasting based on sales of the last 1 or 2 months	Use alternative new method in determining forecasting
Fully manual forecasting	
Low sales forecast accuracy	
Significant gap between target and actual sales	

B. Forecasting

In order to increase forecast accuracy at Bio Farma for the Papua Area, a quantitative method is applied for the alternative analysis data. This study uses the simple moving average method, the weighted moving average method, and exponential smoothing to forecast data using three different statistical techniques. A suggestion for the forecast in the future will be made using the approach with the lowest error value or the best forecast accuracy.

The study is based on two items that were introduced to the market and are in high demand. For the data, 12 months of historical sales are available, which is enough for some of the approaches previously discussed.

1. Forecasting Method Using Simple Moving Average

   Simple moving average is the first approach that is frequently used to estimate future sales, so in this research, an alternative statistic that will be employed is simple moving average with a trial period of three months and five months.

   Three Months Simple Moving Average of Biosat

   From **figure 5**, it can be seen that there are still many gaps between actual demand and forecast number using simple moving average three months.

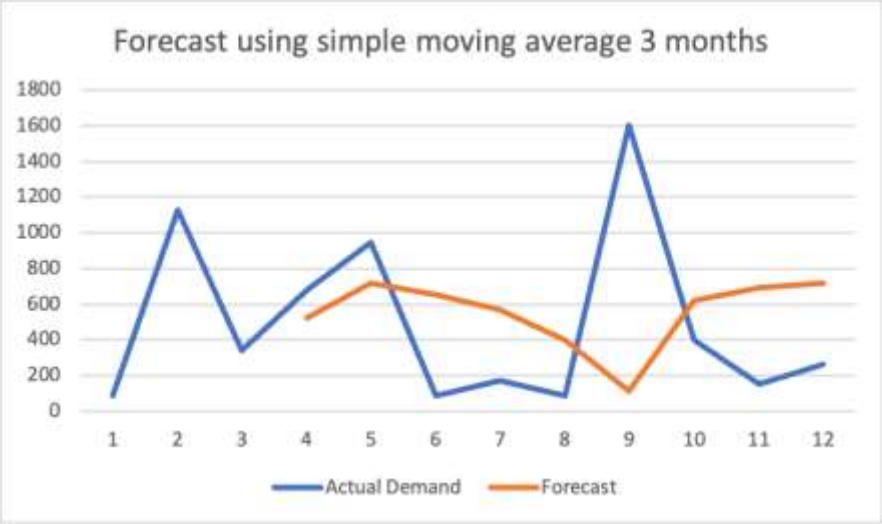

Figure 5. Three months simple moving average of Biosat

Five Months Simple Moving Average

There is a sizable discrepancy when using the five-month simple moving average method for Biosat goods. In the ninth period, the gap is rather large, but it is less so in periods eleven and twelve.

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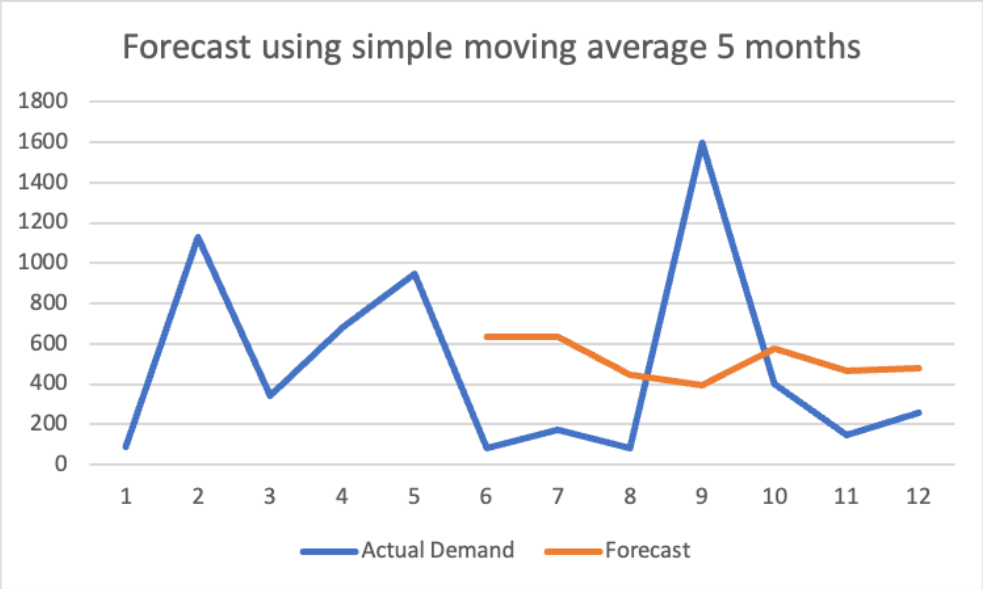

Figure 6. Five months simple moving average of Biosat

Three Months Simple Moving Average of PPD

It can be seen from **Figure 7** that there is a gap but it is not too big when looking at the PPD product demand projection using a three-month simple moving average, especially in the seventh to ninth period.

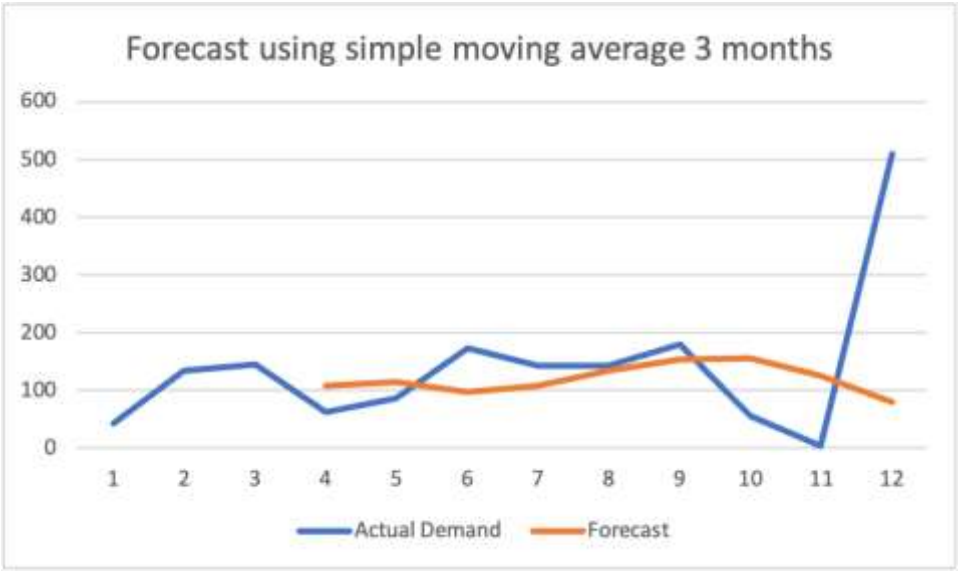

Figure 7. Three months simple moving average of PPD

Five Months Simple Moving Average of PPD

With the exception of the 10 to 12 period, the chart for PPD products tends to be stable when using the five-month simple moving average method.

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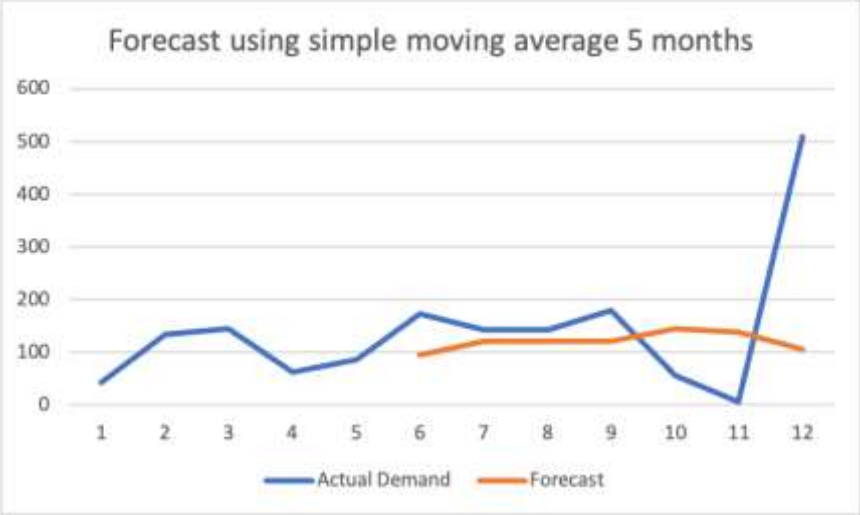

Figure 8. Five months simple moving average of PPD

2. Forecasting Method Using Weighted Moving Average

Weighed moving averages are used as the second forecasting method. Although it uses a similar technique to the previous simple moving average, this one offers an additional benefit. Applying this strategy enables researchers to establish distinct weights for various historical time periods, such as setting a higher weight for more recent periods. But testing is needed in order to be able to employ the right weights. A traditional approach was used in this instance, testing periods from 4 to 12 and 6 to 12 while giving the periods nearer to the most recent prediction period higher weights. For instance, if three previous periods are selected, the nearest period will have a weight of 3, the next two periods would have constant weights of 2, and the final period will have a weight of 1.

Three Months Weighted Moving Average of Biosat

With a total weight of 6, the weights for the forecast calculation are 3 for one month ago, 2 for two months ago, and 1 for three months ago. **Figure 9** shows that there are still significant discrepancies between the forecasted number and the actual demand based on a three-month weighted moving average.

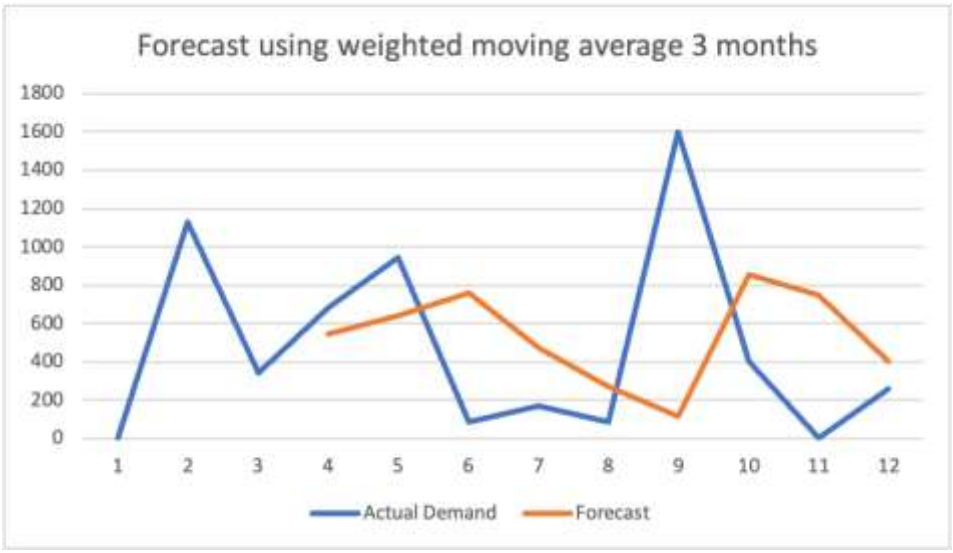

Figure 9. Three months weighted moving average of Biosat

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Five Months Weighted Moving Average of Biosat

The weights used to calculate the forecast are 5 for the previous month, 4 for the previous two months, 3 for the previous three months, 2 for the previous four months, and 1 for the previous five months, for a total weight of 15. **Figure 10** shows that there are still significant discrepancies between the forecasted number and the actual demand using a weighted moving average of five months.

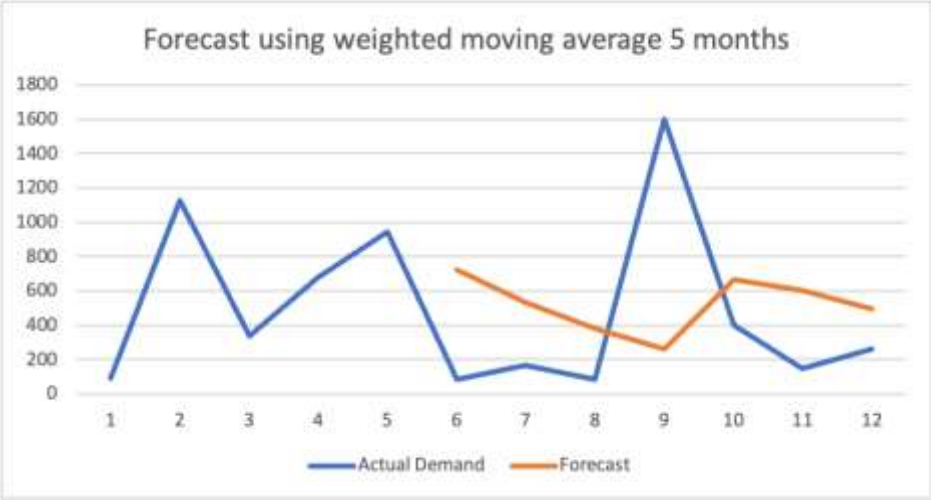

Figure 10. Five months weighted moving average of Biosat

Three Months Weighted Moving Average of PPD

With a total weight of 6, the weights for the forecast calculation are 3 for one month ago, 2 for two months ago, and 1 for three months ago. A pretty smooth graph is displayed when weighted moving average is used on the PPD product, as illustrated in **figure 11.**

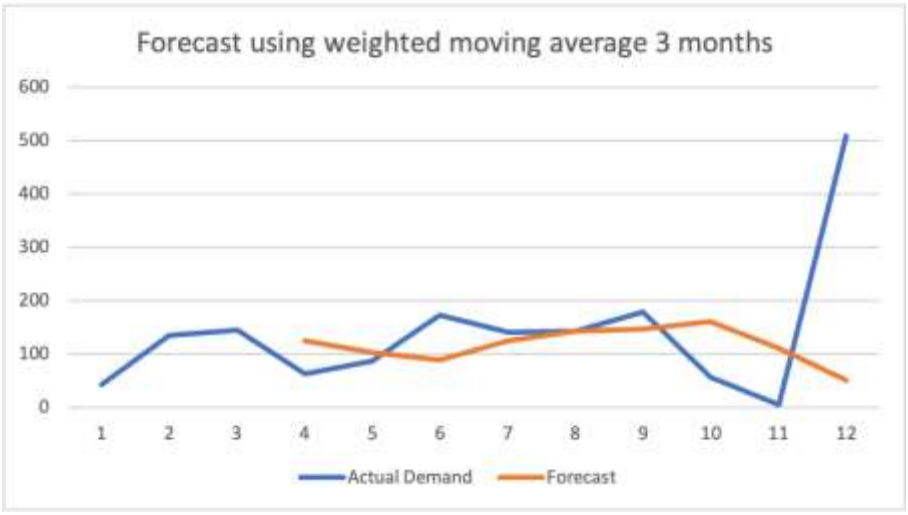

Figure 11. Three months weighted moving average of PPD

Five Months Weighted Moving Average of PPD

The weights used to calculate the forecast are 5 for the previous month, 4 for the previous two months, 3 for the previous three months, 2 for the previous four months, and 1 for the previous five months, for a total weight of 15. Although the graph is not quite as smooth as the three months weighted moving average, the usage of weighted moving average on PPD product as shown in **figure 12** offers a pretty smooth graph.

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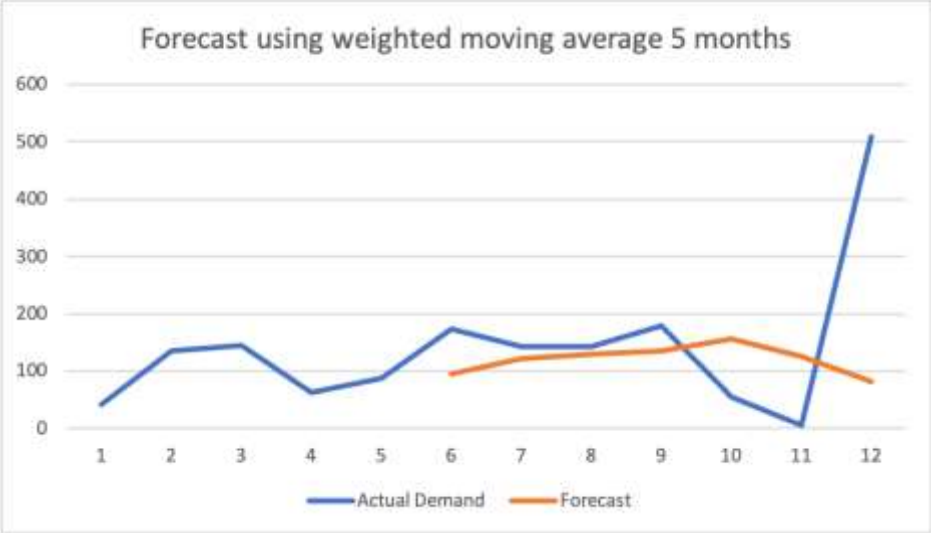

Figure 12. Five months weighted moving average of PPD

3. Forecasting Method Using Exponential Smoothing

Simple exponential smoothing will also be tested as a quantitative model. When compared to weighted moving averages and simple moving averages, this approach has one significant advantage. Because it just needs one previous data point and forecast to take into consideration and then adjusts automatically, it is probably the strategy that works best when there is a limited quantity of data available. Alpha is the primary constant that must be identified. Depending on the characteristics of the products, the alpha value fluctuates between 0 and 1. In this study, alpha was tested between 0.1 and 0.9 to determine the optimal alpha with little mistake.

Exponential Smoothing of Biosat

From the forecast error calculation result using alpha modified, for Biosat product with range from January to December 2022, the best alpha value is 0,1 based on the calculation in appendix A with its MAD is 425 and MAPE 106,3%. **Table 3** shows the comparison of exponential smoothing with alpha 0,1 to 0,9.

Table 3. Forecast Error Comparison of Exponential Smoothing for Biosat with Various Alpha

BIOSAT	∝ = 0,1	∝ = 0,2	∝ = 0,3	∝ = 0,4	∝ = 0,5	∝ = 0,6	∝ = 0,7	∝ = 0,8	∝ = 0,9
MAD	425,0	451,1	430,5	429,4	441,8	455,6	471,0	488,6	508,3
MAPE	106,3	147,6	164,1	179,9	184,6	186,0	185,5	185,8	187,7

It can be shown that a MAPE of 106,3% error indicates to alpha 0,1 as the best solution (See in **Table 3**). MAD in this case shoes the same result with number 425.

Exponential Smoothing of PPD

From the forecast error calculation result using alpha modified, for PPD product with range from January to December 2022, the best alpha value is 0,9 with with its MAPE is 171,7%. **Table IV.12** shows the comparison of exponential smoothing with alpha 0,1 to 0,9.

Table 4. Forecast Error Comparison of Exponential Smoothing for PPD with Various Alpha

PPD	∝ = 0,1	∝ = 0,2	∝ = 0,3	∝ = 0,4	∝ = 0,5	∝ = 0,6	∝ = 0,7	∝ = 0,8	∝ = 0,9
MAD	58	53,5	50,9	49,6	48,8	47,8	47,6	48,1	48,3
MAPE	207,3	242,6	251,5	247,8	237,6	223,1	207,1	190,2	171,7

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It can be shown that a MAPE of 171,7% error indicates to alpha 0,9 as the best solution (See in **table 4**). MAD, which primarily seeks to highlight significant flaws, indicates that the optimal solution is not 0,9. This can be explained by assuming that the alpha 0,9 approach only smoothes out big random fluctuations. Therefore, when there are significant increases in demand, there are also significant increases in accuracy errors. But when it comes to forecasting, when significant deviations are difficult for time series algorithms to identify, this is a common situation.

4. Summary of Forecast Error Analysis

A fundamental component of forecasting is accuracy measurement. Despite this, Bio Farma for Papua Area does not yet assess the precision of its forecasts. Measures of predicting accuracy that have been put into place would benefit the company in a few ways. First of all, it would make it possible to look into and determine the reason for predicting inaccuracies. In order to learn from the past errors, it is essential to comprehend the reason why it happened. Additionally, fixing the issues could enhance the entire forecasting procedure.

The accuracy measuring methods of MAD and MAPE will be used in order to assess each technique's performance. Because MAPE is straightforward and can express inaccuracy as a percentage, it was chosen as the primary accuracy indicator.

The final summary of the various testing techniques is shown in **table 5**, where it is compared to the accuracy measurement tool for Biosat product. The optimum option is constant 0.1, according to MAPE of 106,3% error (See in **table 5**). MAD in this case shows the different results, MAD indicates five month moving average as the most accurate with number 218,2. Although only five data are utilized as accuracy measuring points following the method, as was already mentioned, this method cannot be entirely regarded as reliable. Therefore, since simple exponential smoothing only requires one prior period to begin operating, it would perform better when producing forecasts.

Table 5. Summary of Forecast Error for Biosat

BIOSAT	MAD	MAPE (%)
Three Month Moving Average	232,4	223,4
Five Month Moving Average	218,2	251,8
Three Month Weighted Moving Average	235,7	231,6
Five Month Weighted Moving Average	228,5	265,5
Exponential Smoothing $\propto$ = 0,1	425,0	106,3

The same outcome for PPD products shows that constant 0.9 is the best option, with a MAPE error of 171.7%. (See in **table 6**). In this instance, MAD displays a variety of outcomes; it identifies the five-month weighted moving average as the most accurate with a value of 26.41. Due to the fact that there are only five data points utilized to measure accuracy, as was previously noted, this method cannot be entirely trusted. Therefore, since simple exponential smoothing only requires one prior period to begin operating, it would perform better when producing forecasts.

Table 6. Summary of Forecast Error for PPD

PPD	MAD	MAPE (%)
Three Month Moving Average	29,7	319,8
Five Month Moving Average	27,59	431,7
Three Month Weighted Moving Average	30,2	289,8
Five Month Weighted Moving Average	26,41	395,6
Exponential Smoothing $\propto$ = 0,6	47,8	223,1
Exponential Smoothing $\propto$ = 0,9	48,3	171,7

However, none of the methodologies provide very high levels of accuracy, and it is crucial to realize that a product forecast can be regarded as a forecast under the most uncertain circumstances, in which subjective changes are crucial. All

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techniques need more testing and measurement, and during this period, a specific method should emerge that might be taken into account as a dependable source of future estimates.

CONCLUSION AND RECOMMENDATION

A. Conclusion

After completing the calculations and analysis in the previous sub-chapter, a comparison between each approach is made using the mean absolute percent error (MAPE) and median absolute deviation (MAD). However, due to its ease of use and capacity to express mistakes in percentages, MAPE was chosen as the primary accuracy measure. **Table 7** lists all of the techniques that produced the smallest errors.

Table 7. Proposed Method of Forecasting

Items	MAPE (%)	Method
Biosat	106,3	Exponential Smoothing ∝ = 0,1
PPD	171,7	Exponential Smoothing ∝ = 0,9

According to the test results for the Biosat product, the exponential smoothing method (alpha = 0,1) with a MAPE value of 106,3% has the lowest error from January to December 2022. While for PPD products, exponential smoothing (alpha = 0,9) and a MAPE value of 171,7% result in the lowest error during the period of January to December 2022.

Currently, company does not use any forecasting accuracy measurement tools therefore further improvements can be hardly achieved. Even though only qualitative models are utilized, accuracy tools from MAD, MSE, and MAPE can still be applied. Accuracy model will make it possible to assess performance, identify errors, and produce more accurate forecasting outcomes.

Five models have been tested in terms of the quantitative models. The exponential smoothing technique is recommended because it has the advantage of just requiring one period to complete, which is crucial when there is a limited amount of data available.

From the research results, the following is the answers to the research questions:

1. It can be concluded that the root causes that cause overstock in the Bio Farma Papua Area are as follows:
    a. Lack of employee knowledge about sales forecasting
    b. Sales forecasting based on sales of the last 1 or 2 months
    c. Fully manual forecasting method
    d. Low sales forecast accuracy
    e. Significant gap between target and actual sales
2. Based on the root causes, the right solution is company should track the sales and forecast. By using the forecasting method, Bio Farma Papua Are a can plan for potential future demand and know how many products need to be stored, which helps the company manage its inventory. The goal of this forecast calculation in this research is to assist the company in identifying the forecasting method that works best with each product so that the company can maximize its forecasting. This method can also be applied to other company's product. Since the company doesn't employ any accuracy measuring techniques, they might be deployed right away as a process and performance review tool. In order to learn and improve the sales predicting process, the organization would be able to identify significant forecasting inaccuracies using accuracy measurement.
   When it comes to the approaches that can be employed, mean absolute deviation (MAD) and mean absolute percentage error (MAPE) can be used as instruments for measuring accuracy, and the simple exponential smoothing method is used as a quantitative methodology.

B. Recommendation

Since the study was centered on improvements to the forecasting process, some of the most important possible areas for development can be identified and given to the company as recommendations.

1. The company must evaluate and compare past forecast results with actual demand
2. For the accuracy measurement tools, the company can apply mean absolute deviation (MAD) and mean absolute percentage error (MAPE)

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3. When more historical data becomes available, the company should take into consideration other well-liked techniques including exponential smoothing with trend
4. Since salespeople are the most reliable sources of information, they must be involved in any training or knowledge-sharing on forecasting techniques.

REFERENCES

1. Coccia, M. (2018). The Fishbone Diagram to Identify, Systematize and Analyze The Sources of General Purpose Technologies. https://ssrn.com/abstract=3100011Electroniccopyavailableat:https://ssrn.com/abstract=3100011Electroniccopyavailableat:https://ssrn.com/abstract=3100011
2. Dayanada, Don. (2002). Capital budgeting: Financial Appraisal of Investment Projects. Cambridge University Press.
3. Jacobs, F. R., & Chase, Richard. B. (2018). OPERATIONS AND SUPPLY CHAIN MANAGEMENT.
4. Kahn, K. B. (2014). Solving The Problems of New Product Forecasting. Business Horizons, 57(5), 607–615. https://doi.org/10.1016/j.bushor.2014.05.003
5. Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. In Journal of Advanced Nursing (Vol. 72, Issue 12, pp. 2954–2965). Blackwell Publishing Ltd. https://doi.org/10.1111/jan.13031
6. Martinovic, J., & Damnjanovic, V. (2006). The Sales Forecasting Techniques.
7. Mentzer, John. T., & Moon, Mark. A. (2005). Sales Forecasting Management: A Demand Management Approach. International Journal of Forecasting, 22(4), 821. https://doi.org/10.1016/j.ijforecast.2005.12.001
8. Miles, M. B., & Huberman, A. M. (1994). An Expanded Sourcebook: Qualitative Data Analysis. London: Sage Publications.
9. Narkevičius, R., & Šeškauskis, Ž. (2016). SALES FORECASTING MANAGEMENT.
10. Patel, M., & Patel, N. (2019). Exploring Research Methodology: Review Article. International Journal of Research and Review Keywords: Research, Methodology, Research Methodology, 6. www.ijrrjournal.com
11. Render, B., Stair, R. M., Hanna, M. E., & Hale, T. S. (2012). Quantitative Analysis For Management.

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